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Department of Meteorology and Oceanography
Geophysical Sciences Laboratory Report No. 65-4

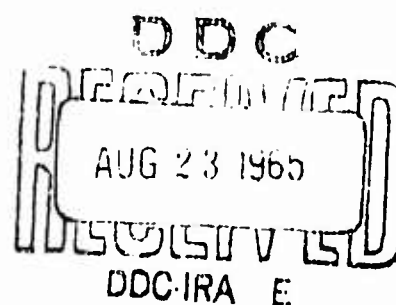
Wave Spectra Estimated from Wave Records Obtained by
the OWS WEATHER EXPLORER and
the OWS WEATHER REPORTER (III)

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by
L. Moskowitz
W. J. Pierson, Jr.
E. Mehr

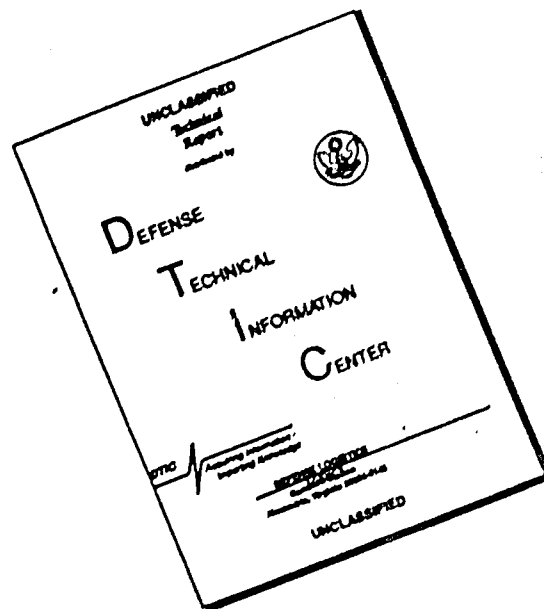
Technical Report Prepared for
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June 1965



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Introduction

As a part of the problem of developing numerical wave forecasting procedures for the North Atlantic Ocean, selected sequences of the weather maps for the North Atlantic for which wave data were known to be available were studied in detail for the five year period beginning in April 1955 and ending in March 1960. Data from a hurricane in September 1961 have also been analyzed. Certain dates and times of observations were selected for a variety of reasons for study. For these dates and times, the National Institute of Oceanography provided copies of the wave records that were obtained by the OWS Weather Explorer and by the OWS Weather Reporter.

In total, about 800 wave records were provided, and a complete spectral analysis has been made for 390 of these records.

This report is the third and final report (Moskowitz, Pierson, and Mehr, 1962, 1963) to present in tabular and graphical form the results of these analyses. The total number of spectra given is 66. The spectra presented in this volume, labeled JHC 194-219, represent the last of the spectra used in the development of a new spectrum for fully developed seas (Pierson and Moskowitz, 1964). Additional spectra are presented (Bretschneider et al, 1962) which were used but published elsewhere for another purpose. These additional spectra are taken from the above reference and shown on two separate sheets without graphs. Chronologically, they should be placed before the group of spectra denoted by JHB 1-32 which appeared in Vol. II. Volumes I and II will soon be reissued under one cover. The confidence limits and graphical tabulations of these appear in the reference cited above. Beneath each column of spectral values are the total variance $(ft)^2$,

significant wave height (ft), total degrees of freedom, and the average period. These spectra are compatible with all the other published spectra since the analysis procedures were exactly the same.

Analysis procedures

The original wave records varied in length, but almost all of this third set were 15 minutes long. The crest to trough heights of the highest waves in a particular record (uncorrected for calibration effects) varied from a few feet to more than 60 feet in the complete set of records. Bounds were set on each record just above the highest wave crest and just below the lowest wave trough, and the records were read to an accuracy of one part in a thousand (nominally) over this range at an interval of 1.5 seconds throughout the record. Thus a 15 minute record was reduced to a time series of 600 points. Where gaps or irregularities occurred, the records were smoothed by hand as accurately as possible.

The time series of 600 points was then analyzed on the CDC 1604 so as to estimate the energy spectrum of the waves at 60 points over the frequency range from zero to 0.333 cycles per second by means of the procedures given by Tukey (1949) as explained in detail by Blackman and Tukey (1958). The smoothing operation that was used to go from L to U in the equations of Blackman and Tukey was

$$(1) \quad U_h = 0.25L_{h-1} + 0.50L_h + 0.25L_{h+1}$$

with suitable corrections at the ends of the range.

The spectral estimates so obtained still had to be corrected for the response of the shipborne wave recorder (Tucker, 1956) and for the introduction of noise in both the original record and in the digitization procedure. The calibration of the shipborne recorder depends on the

ship, and the calibration curves were provided by Mr. D. E. Cartwright for this purpose. The calibration curve for the Weather Explorer is given by Table 1. The calibration curve for the Weather Reporter is given by Table 2. After May 10, 1958, the Weather Reporter made all of the wave observations.

As in another investigation (Bretschneider et al (1962)), it was found that the application of the above calibration curves to the spectra that were originally computed resulted first in a decrease and then a rapid increase in the spectra at high frequencies due to the presence of noise and other irregularities (possibly from nonlinear effects in the original wave records) at the high frequency end of the spectrum. To eliminate this effect, the last part of the spectrum was smoothed by a three point running weighted mean (0.25, 0.50, and 0.25) and then the last ten values were averaged. In the first report of this series, this weighting was carried out as described in that report. The changes in this report should be noted. For comparison the first ten spectra of this report are repeats of the earlier spectra. There is essentially no difference. This average was treated as white noise and subtracted from all spectral estimates. When the reduced values were multiplied by the appropriate calibration curves, the usual result was a fairly smooth spectrum that decreased regularly toward zero values at high frequency. By such a procedure some of the spectral values at high frequency will be negative. These values were automatically set equal to zero in the rest of the computations.

Even with these corrections, there were a few spectra that still became exceptionally large for frequencies greater than about 0.25 cycles per second. This behavior was apparently caused by the

original quality of the record and not by the digitization procedure. These spectra were further modified by arbitrarily setting the calibration curve equal to one above a certain frequency that was selected by inspection of each spectrum.

The result of such a sequence of computations should yield fairly reliable spectral estimates for frequencies ranging from zero to 0.25 cycles per second, but the values at high frequencies should not be used to decide on any features of the high frequency end.

Sample parameter estimates

The spectral estimates that resulted from this sequence of operations were then processed further to obtain some additional useful information. Let U_h^* , for $h = 0, 1, 2, \dots, 60$, represent the spectral estimates (after subtraction of the noise and multiplication by the calibration for the shipborne recorder) in terms of the resolution of the variance of the wave record into frequency intervals. The following quantities were then also computed and tabulated with each spectrum.

$$(2) \quad \text{CORR VAR} = \text{corrected variance} = \sum U_h^*$$

$$(3) \quad \text{SIG HGT} = \bar{H}_{\frac{1}{3}} = 2.83 (2 \sum U_h^*)^{1/2}$$

$$(4) \quad \text{AVER T} = \tilde{T} = [\sum U_h^* / \sum f_h^2 U_h^*]^{1/2}$$

$$(5) \quad \text{TOTAL DF} = \text{Total degrees of freedom} = 10 [\sum U_h^*]^2 / [\sum U_h^{*2}]$$

(for 600 points, 60 lags; i. e., 20 degrees of freedom per spectral estimate)

The confidence intervals on the corrected variance and on the significant height are given by

$$\text{Upper 95\% on CORR VAR} = (10^{+1/\sqrt{\text{TDF}}}) \text{ CORR VAR}$$

(6)

$$\text{Lower 5\% on CORR VAR} = (10^{-1/\sqrt{\text{TDF}}}) \text{ CORR VAR}$$

and by

$$\text{Upper 95\% on } \bar{H}_{\frac{1}{3}} = 10^{+1/2\sqrt{\text{TDF}}} \bar{H}_{\frac{1}{3}}$$

(7)

$$\text{Lower 5\% on } \bar{H}_{\frac{1}{3}} = 10^{-1/2\sqrt{\text{TDF}}} \bar{H}_{\frac{1}{3}}$$

in terms of the total degrees of freedom (TDF) to a high degree of accuracy since the total degrees of freedom are large.

The corrected variance, the significant height, and the total degrees of freedom are relatively insensitive to change in the noise level and in the high frequency behavior of the spectrum. However, the average period can properly be viewed with caution.

The winds at the ship at the time of observation are also given to the nearest five knots as read directly from weather maps when available.

Explanation of tables and graphs

The body of this report consists of supplementary tables, of tables that give the appropriate results for each of the original wave records, and of graphs of each of the estimated spectra along with the confidence intervals on the spectra.

The supplementary tables consist of Tables 1 through 5. Tables 1 and 2 have been described above.

Table 3 gives either the on station position of the ship, A, I, J, or K, or the latitude and longitude of the ship if it is going on or off station. The speed and direction of the ship are given.

Position A corresponds to 62°N, 33°W.

Position I corresponds to 59°N, 19°W.

Position J corresponds to 52.5°N, 20°W.

Position K corresponds to 45°N, 16°W.

If the record was not 15 minutes long, less than 600 points were read. For these records, Table 4 gives the actual number of points used and the corrected total degrees of freedom. A correction to the upper and lower confidence limits, which would be quite small, would also be needed to be exact.

Table 5 consists of date, time and wind speed for each record of the three reports. The wind speeds were extracted from the logs of the weather ships and are recorded to the nearest knot. These wind speeds should be considered to be the most accurate available for the data at hand.

Spectral tabulations

A tabulated spectrum can be interpreted as follows:

- 1a) Supplementary data for each spectrum consist of the date, hour, wind speed, total degrees of freedom, average period, significant height, corrected variance, noise level, and record number. The confidence limits for the height according to equation (7) are given. A zero wind speed represents an unreported wind speed at the time of the observation as read from synoptic charts.
- 1b) In the first column, the spectral lag numbers (H) are given.
- 2) In the second column (FRE) the frequency according to the equation $f = H/180 \text{ (sec}^{-1}\text{)}$ is given.

3) In the third column (UNIT = FT²), the spectrum as computed from the original data is given in units of (ft)².

4) In the fourth column (FILTERED), a smoothing operator for $H > 40$ is applied. It is actually

$$F_H = 0.25U_{H-1} + 0.50U_H + 0.25U_{H+1}$$

(where F = Filtered, and U = Original Tukey Estimate).

5) In the fifth column (LESS NOISE), the noise level shown at the top is subtracted from each estimate.

6) In the sixth column (CORR FT²), the LESS NOISE column is multiplied by the calibration curve for the shipborne record according to either Table 1 or Table 2. If this column agrees with the previous column, at high frequencies, the calibration curve has been arbitrarily set equal to one to avoid extreme values at high frequency.

7) In the last two columns, the upper and lower 95% and 5% confidence bounds are shown.

The format has been changed so that the numbers will be larger and more legible.

Only the spectral values are given from the report by Bretschneider et al. (1962) so as to put all of the available data in one convenient reference.

The graphs of the spectra

The plot that accompanies the spectral tabulation shows the spectrum and the 95% and 5% confidence bounds. A histogram that can be plotted directly by the machine has been used to simplify the presentation. The asterisks represent the upper and lower bounds. The solid

portion represents the outline of the spectrum. The scale is chosen so that the highest 95% confidence value is at the top of the graph and the vertical axis of the coordinate system shows the spectral values for that spectrum in units of (feet)². The scales change with each spectrum and comparisons between spectra by means of the graphs should be made cautiously.

Availability on magnetic tape

The procedures used to carry out the spectral computations necessitate the use of the digitized wave records. If the spectra are to be computed only once this procedure is satisfactory. If further operations or recalculations of the spectra are to be performed, the use of the digitized wave records can be eliminated. The use of the raw spectra (shown in column three of the tabulated spectra) reduces the amount of input data considerably and hence, also speeds up the computer operations. The raw spectra of all the records presented in this report, the previous two reports, and the paper by Bretschneider et al (1962) are available on magnetic tape. For those who may find further use of the raw spectra, additional copies of the tape can be made available.

Acknowledgments

We wish to thank the National Institute of Oceanography of the United Kingdom for providing us with the wave records. Dr. J. Darbyshire sent some of the records to us from South Africa. Mr. D. E. Cartwright and Mr. L. Draper were most helpful in assembling other records at N. I. O. having them copied and forwarding the records to us. The records were digitized at Johns Hopkins University and at the Davidson Laboratory of Stevens Institute of Technology.

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- Tucker, M. J. (1957): A ship-borne wave recorder. Trans. Inst. Naval Arch. , London, 98, 236.
- Tukey, J. W. (1950): The sampling theory of power spectrum estimates. Symposium on Applications of Autocorrelation Analysis to Physical Problems. Woods Hole, Mass. , 13-14 June, 1949, pp. 47-67.

Table 1. Calibration factors for the Weather Explorer. (Vector A)

1.0000					
1.0000	1.0000	1.0000	1.0000	1.0000	1.6157
1.3740	1.2452	1.1746	1.1399	1.1291	1.1343
1.1547	1.1870	1.2304	1.2845	1.3504	1.4277
1.5193	1.6241	1.7444	1.8828	2.0415	2.2243
2.4349	2.6765	2.9523	3.2725	3.6414	4.0714
4.5654	5.1490	5.8190	6.6136	7.5383	8.6338
9.9169	11.4459	13.2691	15.4245	18.0095	21.1086
24.8366	29.3522	34.8079	41.4485	49.5464	59.4548
71.5502	86.5947	105.1503	128.1186	156.7723	192.5202
237.3987	293.8682	365.1736	455.5306	570.2699	716.8705

Table 2. Calibration factors for the Weather Reporter. (Vector B)

1.0000					
1.0000	1.0000	1.0000	1.0000	1.0000	1.5755
1.3277	1.1908	1.1099	1.0630	1.0375	1.0257
1.0260	1.0350	1.0514	1.0633	1.1034	1.1384
1.1805	1.2280	1.2817	1.3424	1.4105	1.4871
1.5731	1.6684	1.7736	1.8918	2.0229	2.1704
2.3321	2.5169	2.7181	2.9479	3.2018	3.4899
3.8088	4.1715	4.5826	5.0408	5.5616	6.1512
6.8201	7.5845	8.4517	9.4439	10.5785	11.8784
13.3689	15.0856	17.0596	19.3530	22.0055	25.0761
28.6529	32.8206	37.6868	43.3807	50.0432	57.8872

Table 3. Position and speed of ship for each record.

<u>Record No.</u>	<u>Position</u>	<u>Heading</u>	<u>Speed (kts)</u>
JHC 194	I	215°	1
195	I	250°	1
196	I		Stopped
199	I	310°	1
201	I	320°	1/2
203	I	310°	1/2
204	I	340°	2
205	I	350°	2
208	I		Stopped
209	I		Stopped
212	I		Stopped
217	I	180°	2
218	I	250°	1
219	I	240°	1

Table 4. Data on short records for which less than 600 points were available.

<u>Record No.</u>	<u>No. of points</u>	<u>Original TDF</u>	<u>Corrected TDF</u>
JHC 197	586	197	192
198	590	192	189
200	590	209	206
202	590	193	190
206	490	166	136
207	420	169	118
210	500	199	166
211	510	221	188
213	570	187	178
214	540	198	178
215	570	171	162
216	590	203	200

Table 5. Master table of record numbers, dates, times and wind speeds extracted from the log of the weather ships. (Parts I and II)

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
DL 1	19/1/58	0	28	30		3	30
2		6	28	31	27/10/58	0	22
3		12	30	32		9	33
4		18	36	33		15	34
5	20/1/58	0	30	34	27/10/58	21	30
6		6	34	35	28/10/58	9	32
7		15	35	36		15	33
8		21	30	37		21	33
9	21/5/58	0	38	38	29/10/58	3	32
10		6	37	39		9	29
11		12	28	40		18	30
12		18	28	41	30/10/58	0	27
13		21	26	42		6	13
14	22/1/58	3	20	43	17/1/59	6	25
15	24/4/58	3	36	44	16/1/59	9	16
16		6	40	45		15	22
17		12	40	46	7/11/59	21	40
18		15	35	47	7/11/59	12	38
19		18	35	48		15	40
20		21	36	49		18	35
21	25/4/58	0	36	50	8/11/59	0	55
22		3	30	51		6	56
23		6	33	52		12	38
24		9	36	53		15	37
25		12	43	54		21	35
26		15	42	55	9/11/59	0	35
27		18	35	56		6	40
28		21	33	57		12	28
29	26/4/58	0	30	58		18	28

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
59	10/11/59	0	30	89		12	25
60		6	35	90		15	25
61	11/9/61	21	7	91		18	23
62	12/9/61	3	10	92		21	23
63		6	11	93	3/10/59	0	23
64		9	11	94		3	27
65		12	10	95		12	9
66		15	11	96		15	6
67	12/9/61	18	10	97	25/7/59	0	26
68		21	8	98		3	24
69	13/9/61	0	8	99		6	25
70		3	8	100		9	25
71		6	8	101		12	27
72		15	9	102		15	27
73 [none]				103		18	23
74	14/9/61	0	7	104		21	23
75		6	5	105	26/7/59	0	20
76	30/1/60	18	33	106	6/4/57	6	30
77		21	42	107		12	28
78	31/1/60	0	43	108		15	30
79		3	39	109		18	28
80		6	48	110		21	26
81		9	41	111		0	21
82		12	40	112	7/4/57	3	23
83		15	40	113		12	25
84		18	36	114		18	30
85		21	40	115	8/4/57	3	30
86	1/2/60	0	35	116		12	21
87		6	12				
88	2/10/59	9	23				

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JH 1	17/1/59	12	35	28	29/1/59	0	40
2		9	33	29		6	35
3		15	35	30		12	34
4		18	34	31		18	38
5		21	31	32	24/1/59	3	35
6	18/1/59	0	23	33		6	38
7		3	22	34	24/1/59	9	45
8	28/3/59	12	19	35		12	30
9		18	31	36		15	32
10	29/3/59	0	37	37		18	32
11		6	37	38		21	21
12		12	27	39	25/1/59	0	16
13		9	27	40		3	19
14		15	29	41	18/12/58	12	40
15		18	27	42		18	42
16		21	27	43	19/12/58	0	40
17	30/3/59	0	29	44		6	27
18		3	27	45		12	41
19		9	21	46		18	39
20	27/1/59	18	22	47		21	48
21	28/1/59	0	34	48	20/12/58	0	50
22		6	27	49		3	50
23		9	40	50		6	47
24		12	50	51		9	45
25		15	48	52		15	41
26		18	50	53		21	47
27		21	50	54	21/12/58	0	43

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JHB 1	22/12/59	0	35	17	25/12/59	0	43
2		6	40	18		6	21
3		12	45	19		12	19
4		15	40	20		15	25
5		18	50	21		18	25
6		21	52	22		21	22
7	23/12/59	0	55	23	26/12/59	0	37
8		3	52	24		6	23
9		6	43	25		9	22
10		9	45	26		12	22
11		12	45	27		15	30
12		21	40	28		21	18
13	24/12/59	3	37	29	27/12/59	3	23
14		6	32	30		9	28
15		12	20	31		15	25
16		18	18	32		21	23

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JHC 1	23/11/56	12	20	31	8/6/55	3	22
2		15	32	32		12	26
3		18	46	33		15	25
4		21	41	34		21	22
5	24/11/56	0	40	35	9/6/55	0	17
6		3	38	36		3	16
7		6	38	37		6	26
8		9	40	38		12	45
9		15	36	39		18	42
10		18	35	40		21	47
11	25/11/56	0	40	41	9/4/55	0	45
12		3	42	42		3	41
13		9	38	43		6	35
14		12	35	44		9	27
15	19/9/55	3	21	45		15	27
16		9	21	46		21	22
17		15	17	47	9/3/58	3	18
18		21	17	48		6	20
19	20/9/55	3	21	49		0	28
20		6	25	50	6/11/56	18	34
21		15	21	51	7/11/56	0	39
22	21/9/55	0	19	52		6	28
23		3	19	53		9	28
24		12	27	54		12	28
25	7/6/55	0	19	55		15	30
26		6	22	56		21	32
27		9	22	57	8/11/56	0	32
28		14	20	58		3	30
29		18	24	59		6	18
30		21	25	60		12	20

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JHC 61	19/6/56	0	20	91		15	39
62		9	15	92		21	39
63		14	20	93	22/3/56	3	37
64		18	19	94		9	19
65	20/6/56	0	20	95		15	17
66		3	18	96		18	21
67		6	19	97	3/11/55	18	28
68		9	20	98	4/11/55	0	28
69		12	19	99		6	36
70		18	15	100		9	48
71	10/5/56	12	24	101		12	50
72		18	38	102		18	28
73	11/5/56	0	43	103		21	22
74		3	43	104	5/11/55	3	35
75		6	44	105		6	32
76		9	40	106		15	30
77		12	42	107		21	35
78		14	41	108	6/11/55	0	24
79		15	40	109		6	19
80		18	45	110	22/5/57	6	15
81		21	38	111		12	19
82	12/5/56	0	30	112		15	18
83		3	30	113		18	20
84	20/3/56	18	29	114		21	23
85		21	39	115	22/5/57	0	25
86	21/3/56	0	29	116	23/5/57	3	27
87		3	35	117		6	25
88		6	35	118		9	21
89		9	37	119		15	14
90		12	37	120	16/4/58	12	20

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JHC 121	16/4/58	18	24	153		12	40
122	17/4/58	0	23	154		15	30
123		6	23	155		18	30
124		12	22	156	6/6/59	0	40
125		18	24	157		3	41
126	18/4/58	3	18	158		6	48
127		6	24	159		9	41
128		12	25	160		12	41
129		18	28	161		15	36
130		21	29	162		18	36
131	19/4/58	3	32	163		21	34
132		9	30	164	7/6/59	3	25
133		15	23	165	11/12/55	3	47
134		21	23	166		9	45
135	10/12/58	0	28	167		12	43
136		3	38	168		15	36
137		6	34	169		18	10
138		9	40	170		21	10
139		12	44	171	12/12/55	0	10
140		15	50	172		3	17
141		18	52	173		9	15
142		21	36	174		15	20
143	11/12/58	0	30	175	13/12/55	0	15
144		3	20	176		9	16
145		6	18	177		15	10
146		15	46	178	14/12/55	0	16
147		18	35	179		6	19
148		21	47	180		12	18
149	12/12/58	0	40	181		18	14
150		3	32	182	15/12/55	0	5
151		6	40	183		6	0
152		9	38	184		18	12

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JHC 185	16/12/55	0	16	190		9	0
186		3	13	191		15	4
187		11	10	192		21	2
188		18	10	193	18/12/59	0	2
189	17/12/55	3	14				

(Part III)

JHC 194	4/3/58	15	40	207		21	20
195		18	45	208	19/11/56	21	30
196	5/3/58	3	40	209	20/11/56	3	18
197		6	40	210		6	15
198		9	40	211		12	28
199		12	40	212		15	38
200		15	40	213		18	40
201		21	40	214		21	48
202	6/3/58	3	35	215	21/11/56	3	42
203		6	35	216		6	32
204		12	40	217		12	35
205		18	20	218		15	32
206	15/12/55	12	8	219		21	23

Record #	Date	Hour	Wind speed	Record #	Date	Hour	Wind speed
JHA 1	15/12/59	3	--	21		12	26
2		6	--	22		15	36
3		12	21	23		18	26
4		18	25	24		21	23
5	16/12/59	0	10	25	19/12/59	0	30
6		6	4	26		3	35
7		12	23	27		6	18
8		18	32	28		9	18
9	17/12/59	0	60	29		12	28
10		3	61	30		15	25
11		6	48	31		18	17
12		9	48	32		21	14
13		12	48	33	20/12/59	0	28
14		15	48	34		6	36
15		18	48	35		12	28
16		21	41	36		18	16
17	18/12/59	0	40	37	21/12/59	0	28
18		3	25	38		6	27
19		6	20	39		12	7
20		9	9	40		17	23

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1

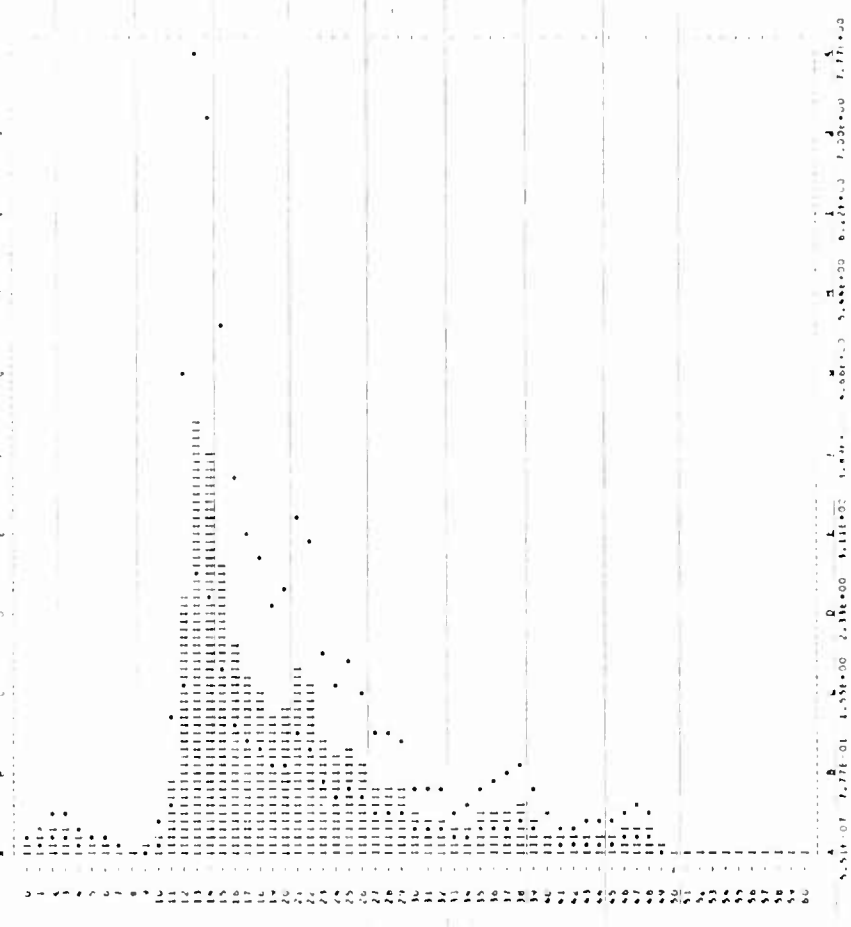
SMOOTHED HINDCASTING SPECTRA COMPUTED APRIL 1963

DATE = 5/ 3/58 AV. T. = 7.5 RECORD = JMC199
 HOUR = 9 SIG. HGT. = 21.3 UPPER HGT. = 21.3
 TOTAL OF -188 CORR. VAR. = 28.4 LOWER HGT. = 13.6
 NOISE LEVEL = .0044 WIND SPEED = 50

N	FREQ. UNIT/SEC	FILTERED	NOISE	CORR. F1/2	UPPER	LOWER
0	.000	.0132	.0132	.0283	.0522	.0180
1	.000	.0619	.0619	.0571	.1052	.0361
2	.011	.1109	.1109	.1260	.2322	.0802
3	.017	.1425	.1425	.1576	.2936	.0876
4	.022	.0779	.0779	.0730	.1346	.0455
5	.028	.0600	.0600	.0551	.1016	.0351
6	.033	.0516	.0516	.0468	.0756	.0281
7	.039	.0236	.0236	.0185	.0284	.0162
8	.046	.0017	.0017	.0000	.0000	.0000
9	.050	.0057	.0057	.0000	.0000	.0000
10	.056	.0082	.0082	.0034	.0222	.0080
11	.061	.0560	.0560	.0511	.11870	.0462
12	.067	2.6136	2.6136	2.4088	7.7123	5.0359
13	.072	3.2407	3.2407	3.2358	7.7368	7.8868
14	.078	1.6900	1.6900	1.6851	2.0031	1.6808
15	.083	.8270	.8270	.8221	1.0115	1.0066
16	.089	1.6288	1.6288	1.6239	1.8249	1.8199
17	.094	1.6769	1.6769	1.6720	2.2574	2.2524
18	.100	.0083	.0083	.0034	.0000	.0000
19	.106	.6296	.6296	.6247	.6852	.6802
20	.111	.6218	.6218	.6169	.6771	.6721
21	.117	.6313	.6313	.6264	.6813	.6763
22	.122	.1230	.1230	.1181	.5982	.1132
23	.128	.2578	.2578	.2530	.5168	.2518
24	.133	.2657	.2657	.2608	.5357	.2607
25	.139	.1973	.1973	.1925	.4666	.1916
26	.146	.2101	.2101	.2052	.4852	.2002
27	.150	.2028	.2028	.1979	.4685	.1935
28	.156	.1306	.1306	.1257	.4118	.1268
29	.161	.0958	.0958	.0909	.3276	.0926
30	.167	.0928	.0928	.0879	.3178	.0899
31	.172	.0783	.0783	.0734	.2684	.0734
32	.178	.0806	.0806	.0757	.2700	.0750
33	.183	.0842	.0842	.0793	.2817	.0767
34	.189	.0844	.0844	.0795	.2825	.0775
35	.194	.0738	.0738	.0689	.2447	.0697
36	.200	.0539	.0539	.0490	.2230	.0480
37	.206	.0373	.0373	.0325	.1220	.0320
38	.211	.0245	.0245	.0196	.0718	.0168
39	.217	.0204	.0204	.0155	.0505	.0155
40	.222	.0171	.0171	.0122	.0373	.0123
41	.228	.0152	.0152	.0103	.0322	.0112
42	.233	.0116	.0116	.0067	.01870	.0067
43	.239	.0086	.0086	.0037	.0128	.0037
44	.245	.0100	.0100	.0051	.0157	.0051
45	.250	.0089	.0089	.0040	.0142	.0040
46	.256	.0078	.0078	.0035	.0123	.0035
47	.261	.0068	.0068	.0024	.0102	.0024
48	.267	.0055	.0055	.0014	.0084	.0014
49	.272	.0041	.0041	.0004	.0062	.0004
50	.278	.0031	.0031	.0004	.0044	.0004
51	.283	.0023	.0023	.0003	.0034	.0003
52	.289	.0016	.0016	.0002	.0023	.0002
53	.294	.0012	.0012	.0001	.0016	.0001
54	.300	.0005	.0005	.0001	.0007	.0000
55	.306	.0000	.0000	.0000	.0000	.0000
56	.311	.0000	.0000	.0000	.0000	.0000
57	.317	.0000	.0000	.0000	.0000	.0000
58	.322	.0000	.0000	.0000	.0000	.0000
59	.328	.0000	.0000	.0000	.0000	.0000
60	.333	.0000	.0000	.0000	.0000	.0000

SMOOTHED HINDCASTING SPECTRA COMPUTED APRIL 1963

DATE = 5/ 3/58 AV. T. = 7.5 RECORD = JMC199
 HOUR = 9 SIG. HGT. = 21.3 UPPER HGT. = 21.3
 TOTAL OF -188 CORR. VAR. = 28.4 LOWER HGT. = 13.6
 NOISE LEVEL = .0044 WIND SPEED = 50



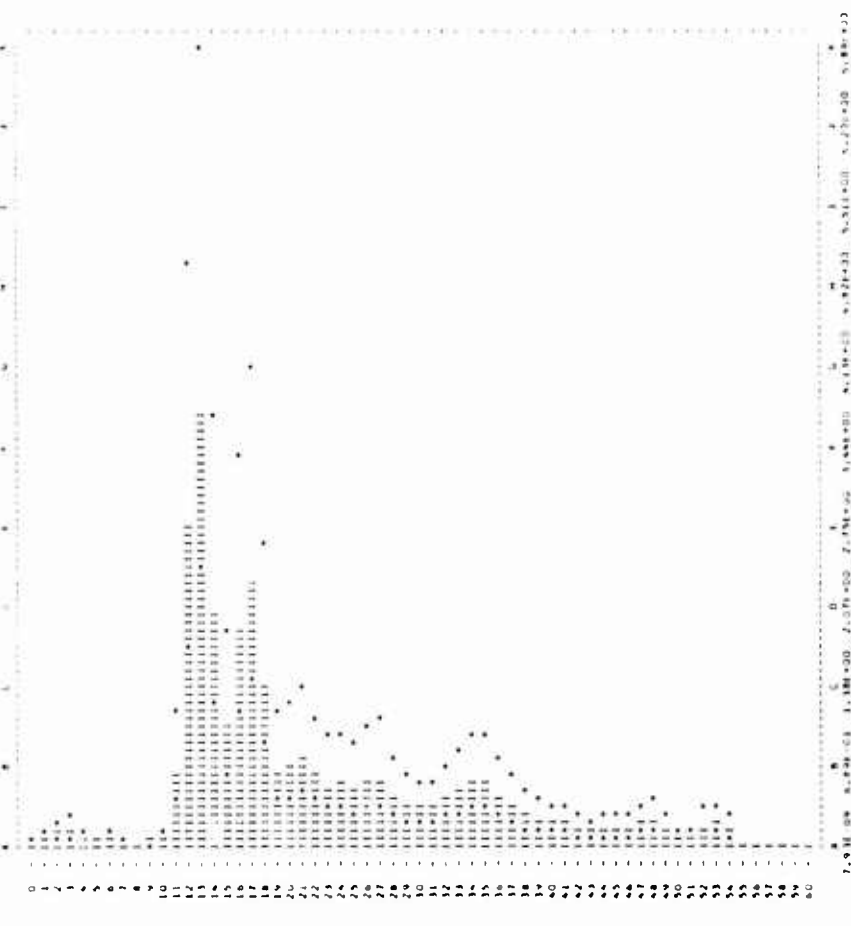
HINDCASTING SPECTRA COMPUTED APRIL 1963

DATE = 5/ 3/58 AV. T. = 7.5 RECORD = JMC199
 HOUR = 12 SIG. HGT. = 21.3 UPPER HGT. = 21.3
 TOTAL OF -188 CORR. VAR. = 28.4 LOWER HGT. = 13.6
 NOISE LEVEL = .0044 WIND SPEED = 50

N	FREQ. UNIT/SEC	FILTERED	NOISE	CORR. F1/2	UPPER	LOWER
0	.000	.0132	.0132	.0283	.0522	.0180
1	.000	.0619	.0619	.0571	.1052	.0361
2	.011	.1109	.1109	.1260	.2322	.0802
3	.017	.1425	.1425	.1576	.2936	.0876
4	.022	.0779	.0779	.0730	.1346	.0455
5	.028	.0600	.0600	.0551	.1016	.0351
6	.033	.0516	.0516	.0468	.0756	.0281
7	.039	.0236	.0236	.0185	.0284	.0162
8	.046	.0017	.0017	.0000	.0000	.0000
9	.050	.0057	.0057	.0000	.0000	.0000
10	.056	.0082	.0082	.0034	.0222	.0080
11	.061	.0560	.0560	.0511	.11870	.0462
12	.067	2.6136	2.6136	2.4088	7.7123	5.0359
13	.072	3.2407	3.2407	3.2358	7.7368	7.8868
14	.078	1.6900	1.6900	1.6851	2.0031	1.6808
15	.083	.8270	.8270	.8221	1.0115	1.0066
16	.089	1.6288	1.6288	1.6239	1.8249	1.8199
17	.094	1.6769	1.6769	1.6720	2.2574	2.2524
18	.100	.0083	.0083	.0034	.0000	.0000
19	.106	.6296	.6296	.6247	.6852	.6802
20	.111	.6218	.6218	.6169	.6771	.6721
21	.117	.6313	.6313	.6264	.6813	.6763
22	.122	.1230	.1230	.1181	.5982	.1132
23	.128	.2578	.2578	.2530	.5168	.2518
24	.133	.2657	.2657	.2608	.5357	.2607
25	.139	.1973	.1973	.1925	.4666	.1916
26	.146	.2101	.2101	.2052	.4852	.2002
27	.150	.2028	.2028	.1979	.4685	.1935
28	.156	.1306	.1306	.1257	.4118	.1268
29	.161	.0958	.0958	.0909	.3276	.0926
30	.167	.0928	.0928	.0879	.3178	.0899
31	.172	.0783	.0783	.0734	.2684	.0734
32	.178	.0806	.0806	.0757	.2700	.0750
33	.183	.0842	.0842	.0793	.2817	.0767
34	.189	.0844	.0844	.0795	.2825	.0775
35	.194	.0738	.0738	.0689	.2447	.0697
36	.200	.0539	.0539	.0490	.2230	.0480
37	.206	.0373	.0373	.0325	.1220	.0320
38	.211	.0245	.0245	.0196	.0718	.0168
39	.217	.0204	.0204	.0155	.0505	.0155
40	.222	.0171	.0171	.0122	.0373	.0123
41	.228	.0152	.0152	.0103	.0322	.0112
42	.233	.0116	.0116	.0067	.01870	.0067
43	.239	.0086	.0086	.0037	.0128	.0037
44	.245	.0100	.0100	.0051	.0157	.0051
45	.250	.0089	.0089	.0040	.0142	.0040
46	.256	.0078	.0078	.0035	.0123	.0035
47	.261	.0068	.0068	.0024	.0102	.0024
48	.267	.0055	.0055	.0014	.0084	.0014
49	.272	.0041	.0041	.0004	.0062	.0004
50	.278	.0031	.0031	.0003	.0044	.0003
51	.283	.0023	.0023	.0002	.0034	.0002
52	.289	.0016	.0016	.0001	.0023	.0001
53	.294	.0012	.0012	.0001	.0016	.0001
54	.300	.0005	.0005	.0001	.0007	.0000
55	.306	.0000	.0000	.0000	.0000	.0000
56	.311	.0000	.0000	.0000	.0000	.0000
57	.317	.0000	.0000	.0000	.0000	.0000
58	.322	.0000	.0000	.0000	.0000	.0000
59	.328	.0000	.0000	.0000	.0000	.0000
60	.333	.0000	.0000	.0000	.0000	.0000

HINDCASTING SPECTRA COMPUTED APRIL 1963

DATE = 5/ 3/58 AV. T. = 7.5 RECORD = JMC199
 HOUR = 12 SIG. HGT. = 21.3 UPPER HGT. = 21.3
 TOTAL OF -188 CORR. VAR. = 28.4 LOWER HGT. = 13.6
 NOISE LEVEL = .0044 WIND SPEED = 50



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[illegible][illegible]

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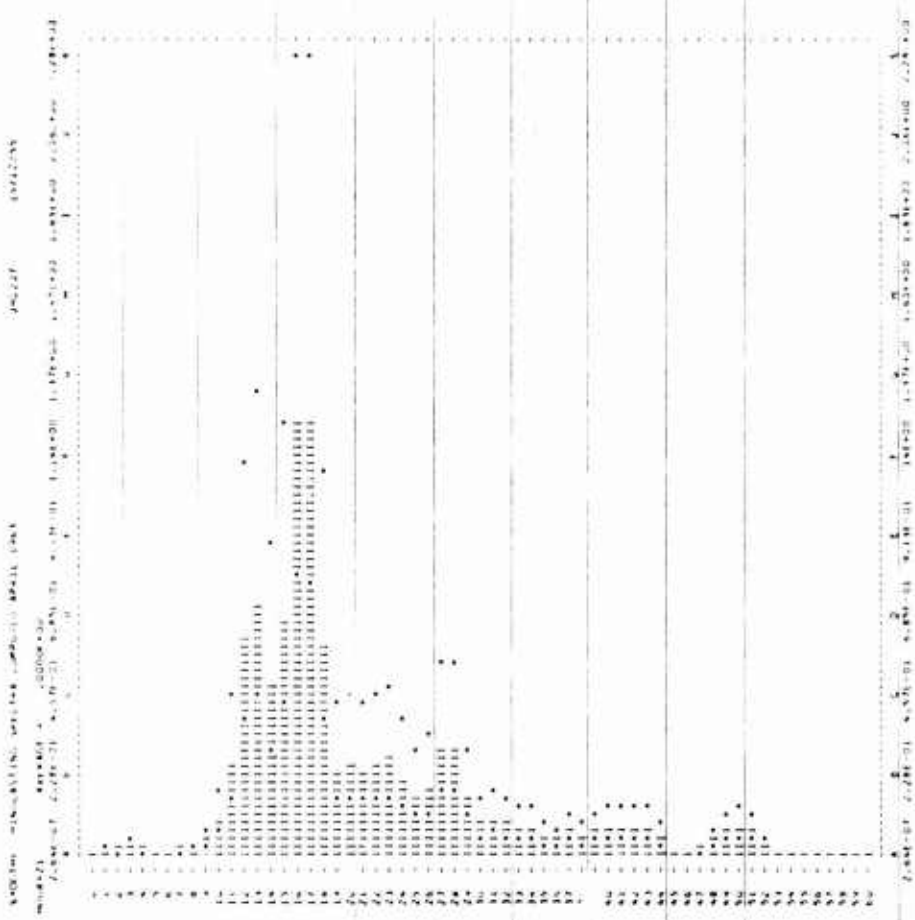
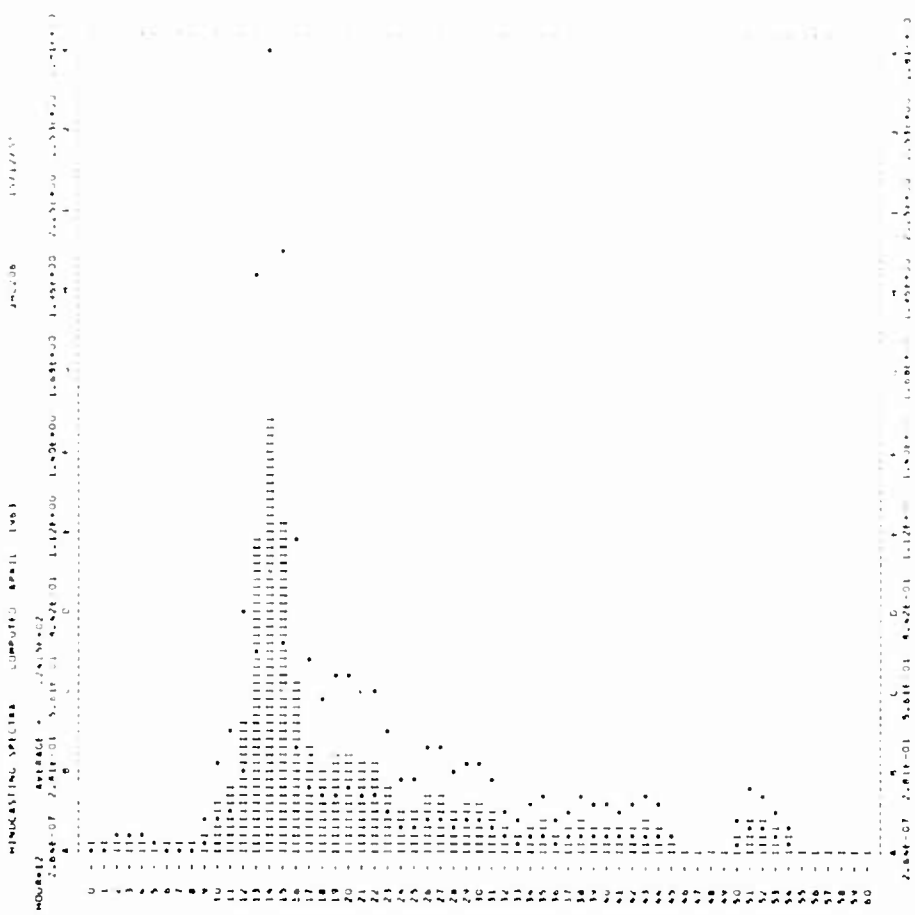
MSDCASTING, INC. 144 100th St. Delta, CO 80621

DATF = 15/12/95	Age = 10	T ₀ = 1	Re = 100	Im = 200
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	NOJED = 0.0000	0.0000	Im = 0.0000	0

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0	.0000	.0001	.0002	.0003	.0004	.0005	.0006	.0007	.0008	.0009	.0010	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0019	.0020	.0021	.0022	.0023	.0024	.0025	.0026	.0027	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0035	.0036	.0037	.0038	.0039	.0040	.0041	.0042	.0043	.0044	.0045	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064	.0065	.0066	.0067	.0068	.0069	.0070	.0071	.0072	.0073	.0074	.0075	.0076	.0077	.0078	.0079	.0080	.0081	.0082	.0083	.0084	.0085	.0086	.0087	.0088	.0089	.0090	.0091	.0092	.0093	.0094	.0095	.0096	.0097	.0098	.0099	.0100
1	.0006	.0007	.0008	.0009	.0010	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0019	.0020	.0021	.0022	.0023	.0024	.0025	.0026	.0027	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0035	.0036	.0037	.0038	.0039	.0040	.0041	.0042	.0043	.0044	.0045	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064	.0065	.0066	.0067	.0068	.0069	.0070	.0071	.0072	.0073	.0074	.0075	.0076	.0077	.0078	.0079	.0080	.0081	.0082	.0083	.0084	.0085	.0086	.0087	.0088	.0089	.0090	.0091	.0092	.0093	.0094	.0095	.0096	.0097	.0098	.0099	.0100						
2	.0011	.0012	.0013	.0014	.0015	.0016	.0017	.0018	.0019	.0020	.0021	.0022	.0023	.0024	.0025	.0026	.0027	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0035	.0036	.0037	.0038	.0039	.0040	.0041	.0042	.0043	.0044	.0045	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064	.0065	.0066	.0067	.0068	.0069	.0070	.0071	.0072	.0073	.0074	.0075	.0076	.0077	.0078	.0079	.0080	.0081	.0082	.0083	.0084	.0085	.0086	.0087	.0088	.0089	.0090	.0091	.0092	.0093	.0094	.0095	.0096	.0097	.0098	.0099	.0100											
3	.0017	.0018	.0019	.0020	.0021	.0022	.0023	.0024	.0025	.0026	.0027	.0028	.0029	.0030	.0031	.0032	.0033	.0034	.0035	.0036	.0037	.0038	.0039	.0040	.0041	.0042	.0043	.0044	.0045	.0046	.0047	.0048	.0049	.0050	.0051	.0052	.0053	.0054	.0055	.0056	.0057	.0058	.0059	.0060	.0061	.0062	.0063	.0064	.0065	.0066	.0067	.0068	.0069	.0070	.0071	.0072	.0073	.0074	.0075	.0076	.0077	.0078	.0079	.0080	.0081	.0082	.0083	.0084	.0085	.0086	.0087	.0088	.0089	.0090	.0091	.0092	.0093	.0094	.0095	.0096	.0097	.0098	.0099	.0100																	
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SMOULDERING INCALCINATING SPECTRA COMPUTED APRIL 1965

DATE	= 15/12/55	Age	= 8.1	Weight (kg)	= 20.0
Height	= 21	Stature	= 12.6	Weight (kg)	= 14.5
FCI	= 1.6	Weight	= 9.4	Weight (kg)	= 11.5
		Weight	= 10.25	Weight (kg)	= 20.0

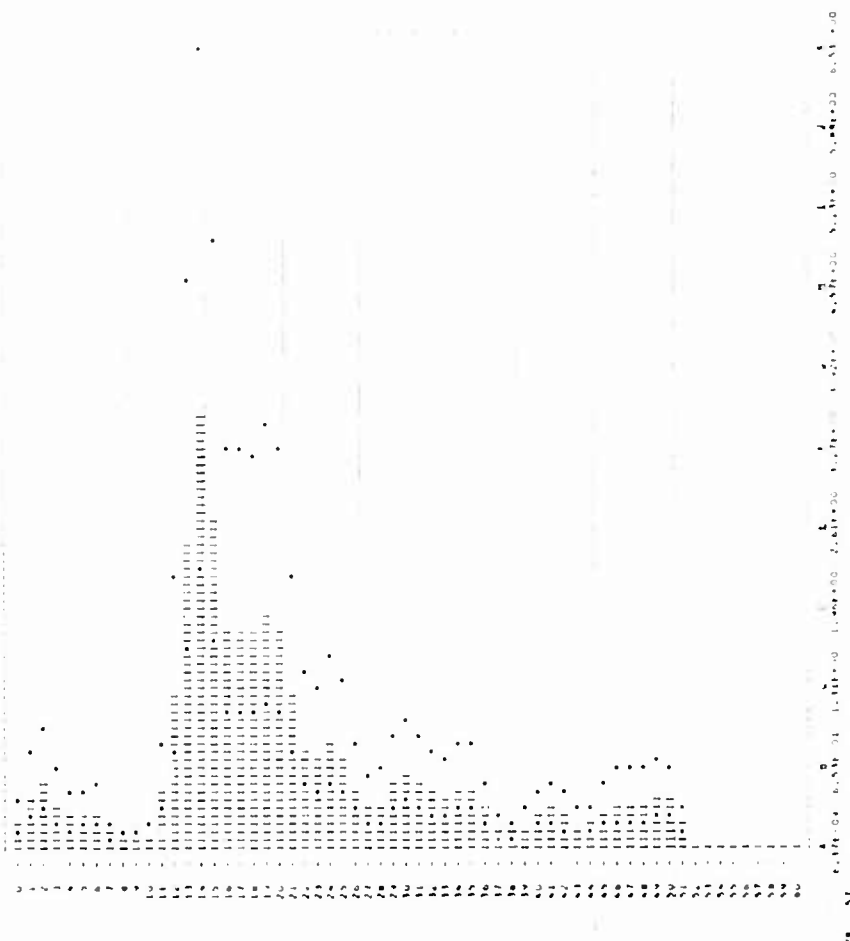
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Abstract



HINOKIESTRINE SPECTRA (COMPILED APRIL 1963)

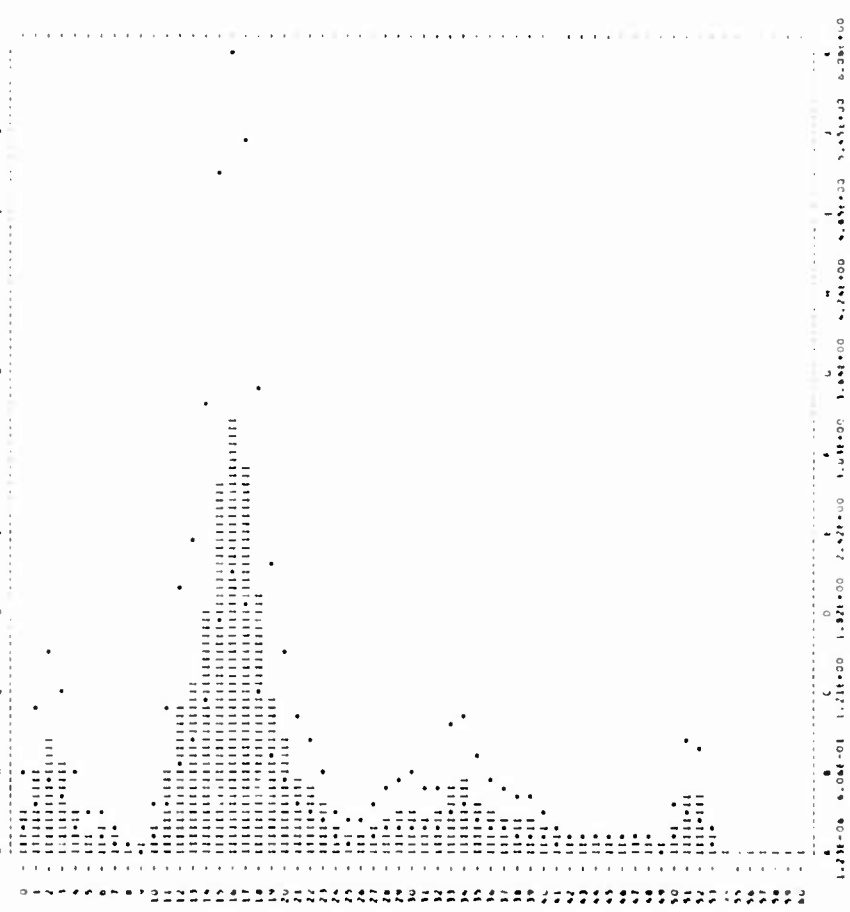
DATE = 20/11/96	Av. 1o	8,0	MEC (MD)	JMC 204
COUR = 3	SIG. MG1.	21,5	UPPER MG1.	21,4
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N	FILE	UNIT-1	UNIT-2	UNIT-3	UNIT-4	UNIT-5	UNIT-6	UNIT-7	UNIT-8	UNIT-9	UNIT-10	UNIT-11	UNIT-12	UNIT-13	UNIT-14	UNIT-15	UNIT-16	UNIT-17	UNIT-18	UNIT-19	UNIT-20	UNIT-21	UNIT-22	UNIT-23	UNIT-24	UNIT-25	UNIT-26	UNIT-27	UNIT-28	UNIT-29	UNIT-30	UNIT-31	UNIT-32	UNIT-33	UNIT-34	UNIT-35	UNIT-36	UNIT-37	UNIT-38	UNIT-39	UNIT-40	UNIT-41	UNIT-42	UNIT-43	UNIT-44	UNIT-45	UNIT-46	UNIT-47	UNIT-48	UNIT-49	UNIT-50	UNIT-51	UNIT-52	UNIT-53	UNIT-54	UNIT-55	UNIT-56	UNIT-57	UNIT-58	UNIT-59	UNIT-60	UNIT-61	UNIT-62	UNIT-63	UNIT-64	UNIT-65	UNIT-66	UNIT-67	UNIT-68	UNIT-69	UNIT-70	UNIT-71	UNIT-72	UNIT-73	UNIT-74	UNIT-75	UNIT-76	UNIT-77	UNIT-78	UNIT-79	UNIT-80	UNIT-81	UNIT-82	UNIT-83	UNIT-84	UNIT-85	UNIT-86	UNIT-87	UNIT-88	UNIT-89	UNIT-90	UNIT-91	UNIT-92	UNIT-93	UNIT-94	UNIT-95	UNIT-96	UNIT-97	UNIT-98	UNIT-99	UNIT-100	UNIT-101	UNIT-102	UNIT-103	UNIT-104	UNIT-105	UNIT-106	UNIT-107	UNIT-108	UNIT-109	UNIT-110	UNIT-111	UNIT-112	UNIT-113	UNIT-114	UNIT-115	UNIT-116	UNIT-117	UNIT-118	UNIT-119	UNIT-120	UNIT-121	UNIT-122	UNIT-123	UNIT-124	UNIT-125	UNIT-126	UNIT-127	UNIT-128	UNIT-129	UNIT-130	UNIT-131	UNIT-132	UNIT-133	UNIT-134	UNIT-135	UNIT-136	UNIT-137	UNIT-138	UNIT-139	UNIT-140	UNIT-141	UNIT-142	UNIT-143	UNIT-144	UNIT-145	UNIT-146	UNIT-147	UNIT-148	UNIT-149	UNIT-150	UNIT-151	UNIT-152	UNIT-153	UNIT-154	UNIT-155	UNIT-156	UNIT-157	UNIT-158	UNIT-159	UNIT-160	UNIT-161	UNIT-162	UNIT-163	UNIT-164	UNIT-165	UNIT-166	UNIT-167	UNIT-168	UNIT-169	UNIT-170	UNIT-171	UNIT-172	UNIT-173	UNIT-174	UNIT-175	UNIT-176	UNIT-177	UNIT-178	UNIT-179	UNIT-180	UNIT-181	UNIT-182	UNIT-183	UNIT-184	UNIT-185	UNIT-186	UNIT-187	UNIT-188	UNIT-189	UNIT-190	UNIT-191	UNIT-192	UNIT-193	UNIT-194	UNIT-195	UNIT-196	UNIT-197	UNIT-198	UNIT-199	UNIT-200	UNIT-201	UNIT-202	UNIT-203	UNIT-204	UNIT-205	UNIT-206	UNIT-207	UNIT-208	UNIT-209	UNIT-210	UNIT-211	UNIT-212	UNIT-213	UNIT-214	UNIT-215	UNIT-216	UNIT-217	UNIT-218	UNIT-219	UNIT-220	UNIT-221	UNIT-222	UNIT-223	UNIT-224	UNIT-225	UNIT-226	UNIT-227	UNIT-228	UNIT-229	UNIT-230	UNIT-231	UNIT-232	UNIT-233	UNIT-234	UNIT-235	UNIT-236	UNIT-237	UNIT-238	UNIT-239	UNIT-240	UNIT-241	UNIT-242	UNIT-243	UNIT-244	UNIT-245	UNIT-246	UNIT-247	UNIT-248	UNIT-249	UNIT-250	UNIT-251	UNIT-252	UNIT-253	UNIT-254	UNIT-255	UNIT-256	UNIT-257	UNIT-258	UNIT-259	UNIT-260	UNIT-261	UNIT-262	UNIT-263	UNIT-264	UNIT-265	UNIT-266	UNIT-267	UNIT-268	UNIT-269	UNIT-270	UNIT-271	UNIT-272	UNIT-273	UNIT-274	UNIT-275	UNIT-276	UNIT-277	UNIT-278	UNIT-279	UNIT-280	UNIT-281	UNIT-282	UNIT-283	UNIT-284	UNIT-285	UNIT-286	UNIT-287	UNIT-288	UNIT-289	UNIT-290	UNIT-291	UNIT-292	UNIT-293	UNIT-294	UNIT-295	UNIT-296	UNIT-297	UNIT-298	UNIT-299	UNIT-300	UNIT-301	UNIT-302	UNIT-303	UNIT-304	UNIT-305	UNIT-306	UNIT-307	UNIT-308	UNIT-309	UNIT-310	UNIT-311	UNIT-312	UNIT-313	UNIT-314	UNIT-315	UNIT-316	UNIT-317	UNIT-318	UNIT-319	UNIT-320	UNIT-321	UNIT-322	UNIT-323	UNIT-324	UNIT-325	UNIT-326	UNIT-327	UNIT-328	UNIT-329	UNIT-330	UNIT-331	UNIT-332	UNIT-333	UNIT-334	UNIT-335	UNIT-336	UNIT-337	UNIT-338	UNIT-339	UNIT-340	UNIT-341	UNIT-342	UNIT-343	UNIT-344	UNIT-345	UNIT-346	UNIT-347	UNIT-348	UNIT-349	UNIT-350	UNIT-351	UNIT-352	UNIT-353	UNIT-354	UNIT-355	UNIT-356	UNIT-357	UNIT-358	UNIT-359	UNIT-360	UNIT-361	UNIT-362	UNIT-363	UNIT-364	UNIT-365	UNIT-366	UNIT-367	UNIT-368	UNIT-369	UNIT-370	UNIT-371	UNIT-372	UNIT-373	UNIT-374	UNIT-375	UNIT-376	UNIT-377	UNIT-378	UNIT-379	UNIT-380	UNIT-381	UNIT-382	UNIT-383	UNIT-384	UNIT-385	UNIT-386	UNIT-387	UNIT-388	UNIT-389	UNIT-390	UNIT-391	UNIT-392	UNIT-393	UNIT-394	UNIT-395	UNIT-396	UNIT-397	UNIT-398	UNIT-399	UNIT-400	UNIT-401	UNIT-402	UNIT-403	UNIT-404	UNIT-405	UNIT-406	UNIT-407	UNIT-408	UNIT-409	UNIT-410	UNIT-411	UNIT-412	UNIT-413	UNIT-414	UNIT-415	UNIT-416	UNIT-417	UNIT-418	UNIT-419	UNIT-420	UNIT-421	UNIT-422	UNIT-423	UNIT-424	UNIT-425	UNIT-426	UNIT-427	UNIT-428	UNIT-429	UNIT-430	UNIT-431	UNIT-432	UNIT-433	UNIT-434	UNIT-435	UNIT-436	UNIT-437	UNIT-438	UNIT-439	UNIT-440	UNIT-441	UNIT-442	UNIT-443	UNIT-444	UNIT-445	UNIT-446	UNIT-447	UNIT-448	UNIT-449	UNIT-450	UNIT-451	UNIT-452	UNIT-453	UNIT-454	UNIT-455	UNIT-456	UNIT-457	UNIT-458	UNIT-459	UNIT-460	UNIT-461	UNIT-462	UNIT-463	UNIT-464	UNIT-465	UNIT-466	UNIT-467	UNIT-468	UNIT-469	UNIT-470	UNIT-471	UNIT-472	UNIT-473	UNIT-474	UNIT-475	UNIT-476	UNIT-477	UNIT-478	UNIT-479	UNIT-480	UNIT-481	UNIT-482	UNIT-483	UNIT-484	UNIT-485	UNIT-486	UNIT-487	UNIT-488	UNIT-489	UNIT-490	UNIT-491	UNIT-492	UNIT-493	UNIT-494	UNIT-495	UNIT-496	UNIT-497	UNIT-498	UNIT-499	UNIT-500	UNIT-501	UNIT-502	UNIT-503	UNIT-504	UNIT-505	UNIT-506	UNIT-507	UNIT-508	UNIT-509	UNIT-510	UNIT-511	UNIT-512	UNIT-513	UNIT-514	UNIT-515	UNIT-516	UNIT-517	UNIT-518	UNIT-519	UNIT-520	UNIT-521	UNIT-522	UNIT-523	UNIT-524	UNIT-525	UNIT-526	UNIT-527	UNIT-528	UNIT-529	UNIT-530	UNIT-531	UNIT-532	UNIT-533	UNIT-534	UNIT-535	UNIT-536	UNIT-537	UNIT-538	UNIT-539	UNIT-540	UNIT-541	UNIT-542	UNIT-543	UNIT-544	UNIT-545	UNIT-546	UNIT-547	UNIT-548	UNIT-549	UNIT-550	UNIT-551	UNIT-552	UNIT-553	UNIT-554	UNIT-555	UNIT-556	UNIT-557	UNIT-558	UNIT-559	UNIT-560	UNIT-561	UNIT-562	UNIT-563	UNIT-564	UNIT-565	UNIT-566	UNIT-56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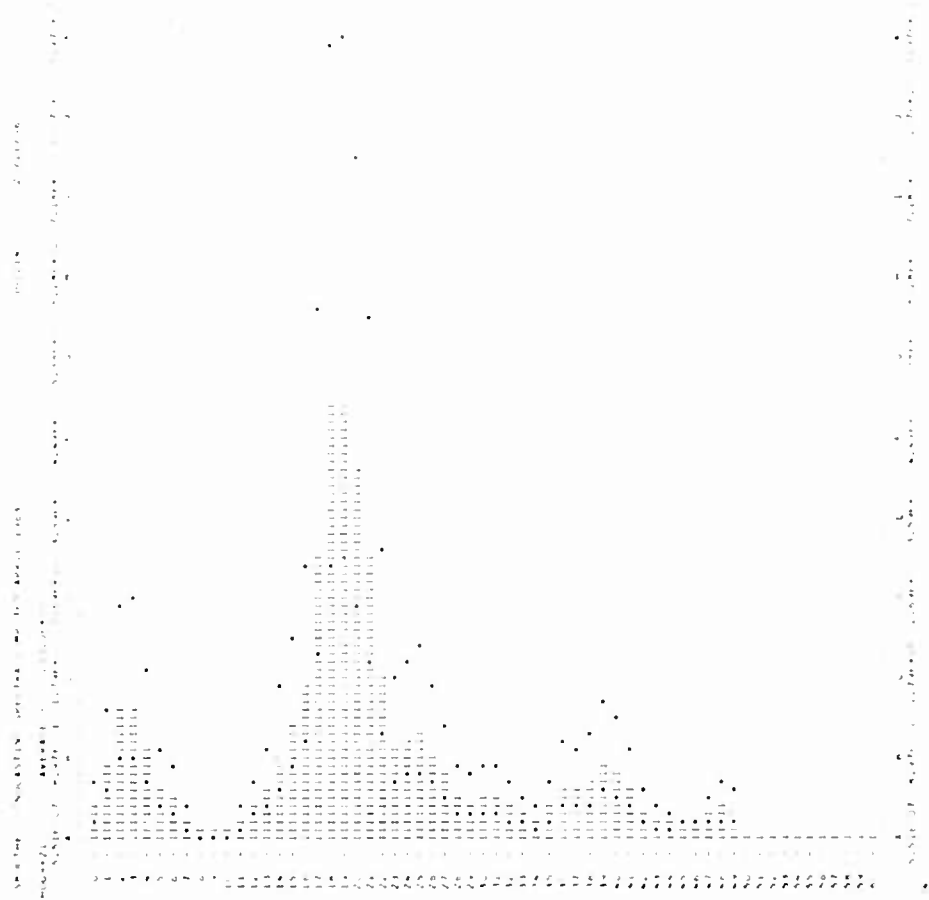
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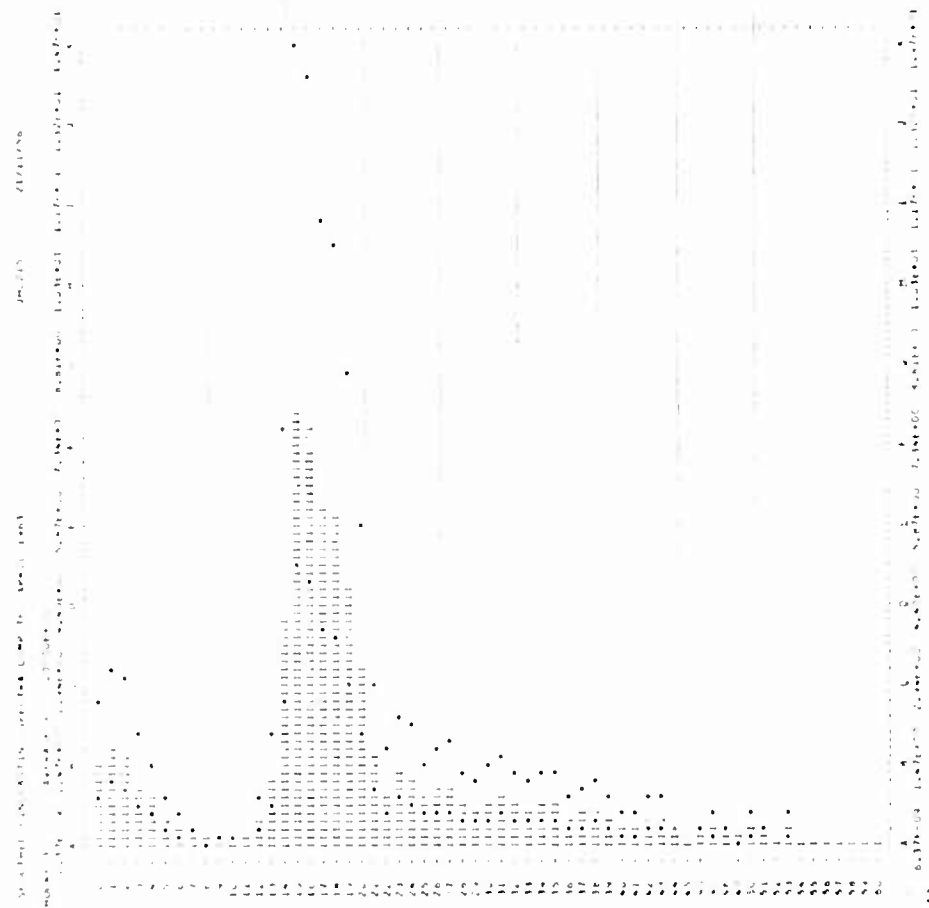
UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C.
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UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PLANT INDUSTRY
WASHINGTON, D. C.
1917

NO.	DATE	PLANT	COLLECTOR	LOCALITY	ALTITUDE	REMARKS
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22/11/50

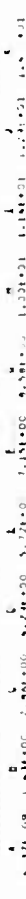
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05/17/12

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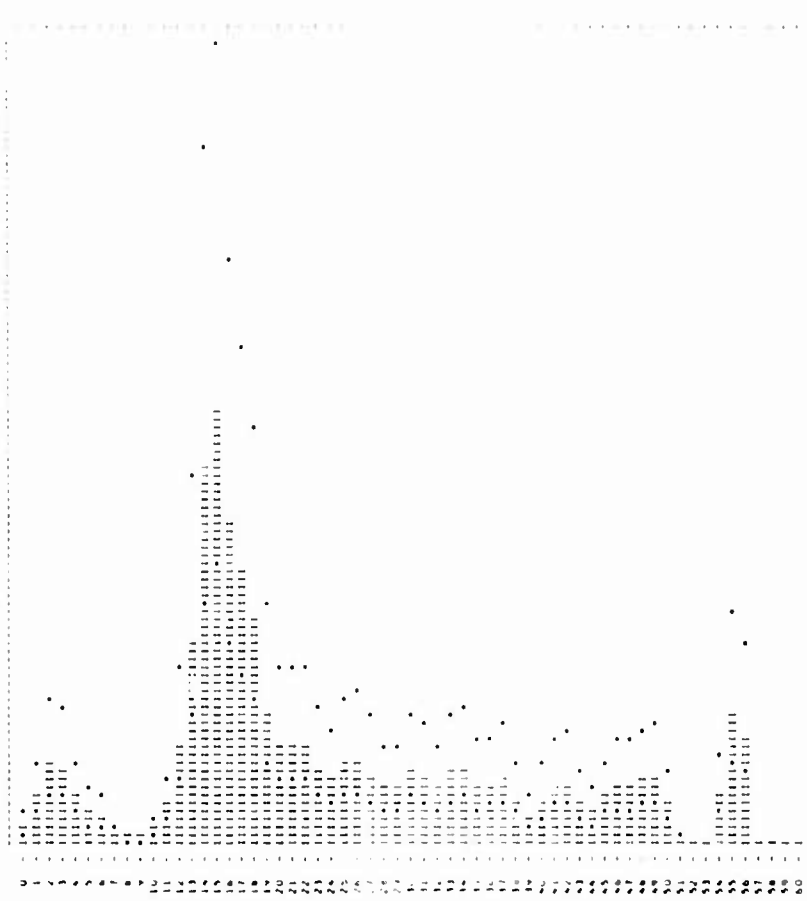


HINDCASTING SPECTRA COMPUTED APRIL 1963

DATE = 2/1/1956
 HOUR = 15
 TOTAL DB = 26.7
 SITUATION = 15
 CORR. F44 = 0.000
 NOISE LEVEL = 0.000
 WIND SPEED = 32
 RECORD = JMC218
 UPPER HGT. = 15.0
 LOWER HGT. = 10.4

H	F41	UNIT F1.2	FILTERED	NOISE	LOW F1.2	UPPER	LOWER
0	.000	.2818	.2818	.0000	.2818	.2818	.2818
1	.006	.2850	.2850	.0000	.2850	.2850	.2850
2	.011	.2886	.2886	.0000	.2886	.2886	.2886
3	.017	.2927	.2927	.0000	.2927	.2927	.2927
4	.022	.2972	.2972	.0000	.2972	.2972	.2972
5	.028	.3021	.3021	.0000	.3021	.3021	.3021
6	.034	.3073	.3073	.0000	.3073	.3073	.3073
7	.039	.3128	.3128	.0000	.3128	.3128	.3128
8	.046	.3186	.3186	.0000	.3186	.3186	.3186
9	.050	.3247	.3247	.0000	.3247	.3247	.3247
10	.056	.3311	.3311	.0000	.3311	.3311	.3311
11	.061	.3378	.3378	.0000	.3378	.3378	.3378
12	.067	.3447	.3447	.0000	.3447	.3447	.3447
13	.072	.3518	.3518	.0000	.3518	.3518	.3518
14	.078	.3591	.3591	.0000	.3591	.3591	.3591
15	.083	.3666	.3666	.0000	.3666	.3666	.3666
16	.089	.3743	.3743	.0000	.3743	.3743	.3743
17	.094	.3821	.3821	.0000	.3821	.3821	.3821
18	.100	.3901	.3901	.0000	.3901	.3901	.3901
19	.106	.3982	.3982	.0000	.3982	.3982	.3982
20	.111	.4065	.4065	.0000	.4065	.4065	.4065
21	.117	.4150	.4150	.0000	.4150	.4150	.4150
22	.122	.4237	.4237	.0000	.4237	.4237	.4237
23	.128	.4326	.4326	.0000	.4326	.4326	.4326
24	.133	.4417	.4417	.0000	.4417	.4417	.4417
25	.139	.4510	.4510	.0000	.4510	.4510	.4510
26	.146	.4605	.4605	.0000	.4605	.4605	.4605
27	.150	.4702	.4702	.0000	.4702	.4702	.4702
28	.156	.4801	.4801	.0000	.4801	.4801	.4801
29	.161	.4901	.4901	.0000	.4901	.4901	.4901
30	.167	.5003	.5003	.0000	.5003	.5003	.5003
31	.172	.5106	.5106	.0000	.5106	.5106	.5106
32	.178	.5211	.5211	.0000	.5211	.5211	.5211
33	.183	.5318	.5318	.0000	.5318	.5318	.5318
34	.189	.5426	.5426	.0000	.5426	.5426	.5426
35	.194	.5536	.5536	.0000	.5536	.5536	.5536
36	.200	.5647	.5647	.0000	.5647	.5647	.5647
37	.206	.5759	.5759	.0000	.5759	.5759	.5759
38	.211	.5872	.5872	.0000	.5872	.5872	.5872
39	.217	.5987	.5987	.0000	.5987	.5987	.5987
40	.222	.6103	.6103	.0000	.6103	.6103	.6103
41	.228	.6220	.6220	.0000	.6220	.6220	.6220
42	.233	.6339	.6339	.0000	.6339	.6339	.6339
43	.239	.6459	.6459	.0000	.6459	.6459	.6459
44	.245	.6580	.6580	.0000	.6580	.6580	.6580
45	.251	.6702	.6702	.0000	.6702	.6702	.6702
46	.256	.6826	.6826	.0000	.6826	.6826	.6826
47	.261	.6951	.6951	.0000	.6951	.6951	.6951
48	.267	.7077	.7077	.0000	.7077	.7077	.7077
49	.272	.7204	.7204	.0000	.7204	.7204	.7204
50	.278	.7332	.7332	.0000	.7332	.7332	.7332
51	.283	.7461	.7461	.0000	.7461	.7461	.7461
52	.289	.7591	.7591	.0000	.7591	.7591	.7591
53	.294	.7722	.7722	.0000	.7722	.7722	.7722
54	.300	.7854	.7854	.0000	.7854	.7854	.7854
55	.306	.7987	.7987	.0000	.7987	.7987	.7987
56	.311	.8121	.8121	.0000	.8121	.8121	.8121
57	.317	.8256	.8256	.0000	.8256	.8256	.8256
58	.322	.8392	.8392	.0000	.8392	.8392	.8392
59	.328	.8529	.8529	.0000	.8529	.8529	.8529
60	.333	.8667	.8667	.0000	.8667	.8667	.8667

HINDCASTING SPECTRA COMPUTED APRIL 1963
 AVERAGE = 1.00E+00
 WIND = 32
 UPPER HGT. = 15.0
 LOWER HGT. = 10.4

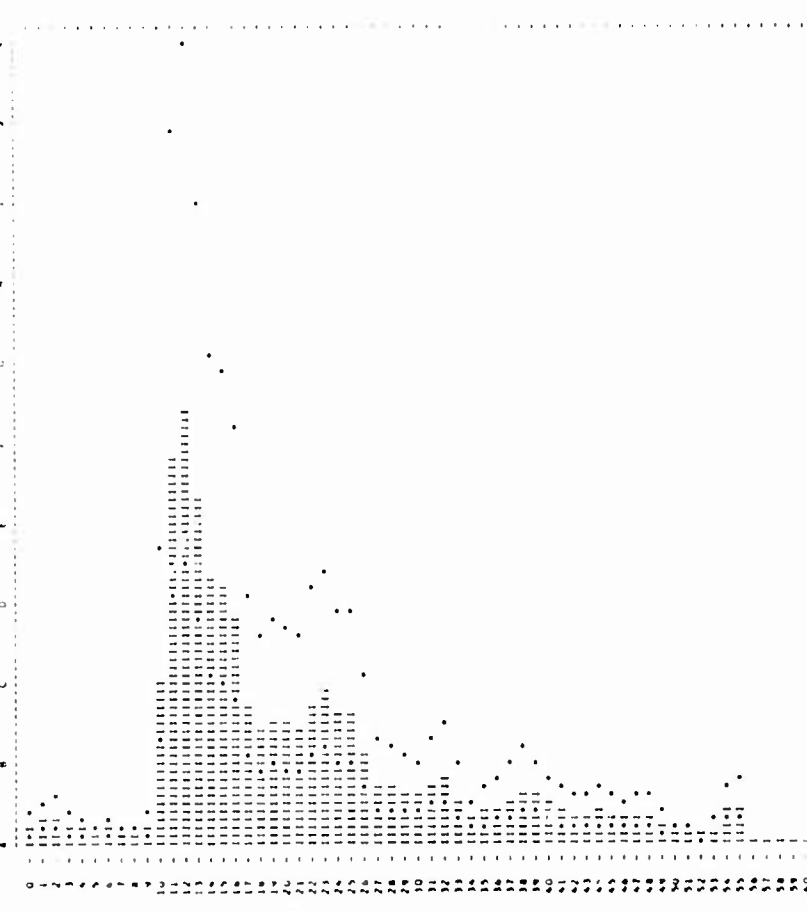


HINDCASTING SPECTRA COMPUTED APRIL 1963

DATE = 2/1/1956
 HOUR = 21
 TOTAL DB = 22.6
 SITUATION = 15
 CORR. F44 = 0.000
 NOISE LEVEL = 0.000
 WIND SPEED = 28
 RECORD = JMC219
 UPPER HGT. = 15.0
 LOWER HGT. = 10.4

H	F41	UNIT F1.2	FILTERED	NOISE	LOW F1.2	UPPER	LOWER
0	.000	.2210	.2210	.0000	.2210	.2210	.2210
1	.006	.2270	.2270	.0000	.2270	.2270	.2270
2	.011	.2336	.2336	.0000	.2336	.2336	.2336
3	.017	.2406	.2406	.0000	.2406	.2406	.2406
4	.022	.2480	.2480	.0000	.2480	.2480	.2480
5	.028	.2557	.2557	.0000	.2557	.2557	.2557
6	.034	.2637	.2637	.0000	.2637	.2637	.2637
7	.039	.2719	.2719	.0000	.2719	.2719	.2719
8	.046	.2803	.2803	.0000	.2803	.2803	.2803
9	.050	.2889	.2889	.0000	.2889	.2889	.2889
10	.056	.2977	.2977	.0000	.2977	.2977	.2977
11	.061	.3067	.3067	.0000	.3067	.3067	.3067
12	.067	.3159	.3159	.0000	.3159	.3159	.3159
13	.072	.3253	.3253	.0000	.3253	.3253	.3253
14	.078	.3349	.3349	.0000	.3349	.3349	.3349
15	.083	.3447	.3447	.0000	.3447	.3447	.3447
16	.089	.3546	.3546	.0000	.3546	.3546	.3546
17	.094	.3647	.3647	.0000	.3647	.3647	.3647
18	.100	.3749	.3749	.0000	.3749	.3749	.3749
19	.106	.3853	.3853	.0000	.3853	.3853	.3853
20	.111	.3958	.3958	.0000	.3958	.3958	.3958
21	.117	.4065	.4065	.0000	.4065	.4065	.4065
22	.122	.4173	.4173	.0000	.4173	.4173	.4173
23	.128	.4283	.4283	.0000	.4283	.4283	.4283
24	.133	.4394	.4394	.0000	.4394	.4394	.4394
25	.139	.4506	.4506	.0000	.4506	.4506	.4506
26	.146	.4620	.4620	.0000	.4620	.4620	.4620
27	.150	.4735	.4735	.0000	.4735	.4735	.4735
28	.156	.4851	.4851	.0000	.4851	.4851	.4851
29	.161	.4968	.4968	.0000	.4968	.4968	.4968
30	.167	.5086	.5086	.0000	.5086	.5086	.5086
31	.172	.5205	.5205	.0000	.5205	.5205	.5205
32	.178	.5325	.5325	.0000	.5325	.5325	.5325
33	.183	.5446	.5446	.0000	.5446	.5446	.5446
34	.189	.5567	.5567	.0000	.5567	.5567	.5567
35	.194	.5690	.5690	.0000	.5690	.5690	.5690
36	.200	.5813	.5813	.0000	.5813	.5813	.5813
37	.206	.5937	.5937	.0000	.5937	.5937	.5937
38	.211	.6062	.6062	.0000	.6062	.6062	.6062
39	.217	.6187	.6187	.0000	.6187	.6187	.6187
40	.222	.6313	.6313	.0000	.6313	.6313	.6313
41	.228	.6440	.6440	.0000	.6440	.6440	.6440
42	.233	.6567	.6567	.0000	.6567	.6567	.6567
43	.239	.6695	.6695	.0000	.6695	.6695	.6695
44	.245	.6824	.6824	.0000	.6824	.6824	.6824
45	.251	.6953	.6953	.0000	.6953	.6953	.6953
46	.256	.7083	.7083	.0000	.7083	.7083	.7083
47	.261	.7213	.7213	.0000	.7213	.7213	.7213
48	.267	.7344	.7344	.0000	.7344	.7344	.7344
49	.272	.7475	.7475	.0000	.7475	.7475	.7475
50	.278	.7606	.7606	.0000	.7606	.7606	.7606
51	.283	.7738	.7738	.0000	.7738	.7738	.7738
52	.289	.7870	.7870	.0000	.7870	.7870	.7870
53	.294	.8003	.8003	.0000	.8003	.8003	.8003
54	.300	.8136	.8136	.0000	.8136	.8136	.8136
55	.306	.8270	.8270	.0000	.8270	.8270	.8270
56	.311	.8404	.8404	.0000	.8404	.8404	.8404
57	.317	.8538	.8538	.0000	.8538	.8538	.8538
58	.322	.8673	.8673	.0000	.8673	.8673	.8673
59	.328	.8808	.8808	.0000	.8808	.8808	.8808
60	.333	.8943	.8943	.0000	.8943	.8943	.8943

HINDCASTING SPECTRA COMPUTED APRIL 1963
 AVERAGE = 1.00E+00
 WIND = 28
 UPPER HGT. = 15.0
 LOWER HGT. = 10.4



Wave Spectra Computed from Wave Records Obtained by 11

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Wave Records Obtained by the OWS "Weather Reporter"

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